# DISINCENTIVE EFFECTS OF SOCIAL SECURITY SYSTEM WITH DISABILITY INSURANCE COVERAGE ON LABOR MARKET

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A simple look at the performance of the Brazilian Disability Benefits on the last years would puzzle any observer and raise number of questions. What caused the abrupt increment in the number of benefits after 2001? Given that, what are (if there is any) the disincentives created by the current rules of the system? This paper will study the impact of the existence of a Public Social Security System which provides disability insurance benefits on the labor market. The empirical strategy will be based on the system's rule that covers only formal sector workers and it will take advantage of the considerate proportion of workers on informal jobs in the Brazilian labor market. The results reveal that workers in the formal sector have higher probability to be on leave, even after controlling for health conditions, which suggests the degree of disincentive created by such social protection system.

Analisar a performace dos benefícios de auxílio-doença no Brasil nos últimos anos intriga qualquer observador e levanta uma série de questões. O que causou tamanho aumento no número de benefícios depois de 2001? Considerando estes fatos, quais são (se existe algum) os desincentivos criados pelas regras atuais do sistema? Este trabalho irá estudar o impacto da existência de um sistema de previdência social que propicia auxílio-doença. A estratégia empírica será baseada nas regras do sistema que somente cobre trabalhadores do setor formal e irá tirar vantagem do enorme setor informal do mercado de trabalho brasileiro. Os resultados revelam que trabalhadores do setor formal têm maior probabilidade de estar afastado do trabalho, mesmo após controlar-se pelas condições de saúde, o que sugere o grau de desincentivo criado por tal sistema de proteção.

Key Words: Disincentive Effects on Labor Market, Disability Insurance
Palavra-Chave: Desincentivos no Mercado de Trabalho, Auxílio-Doença

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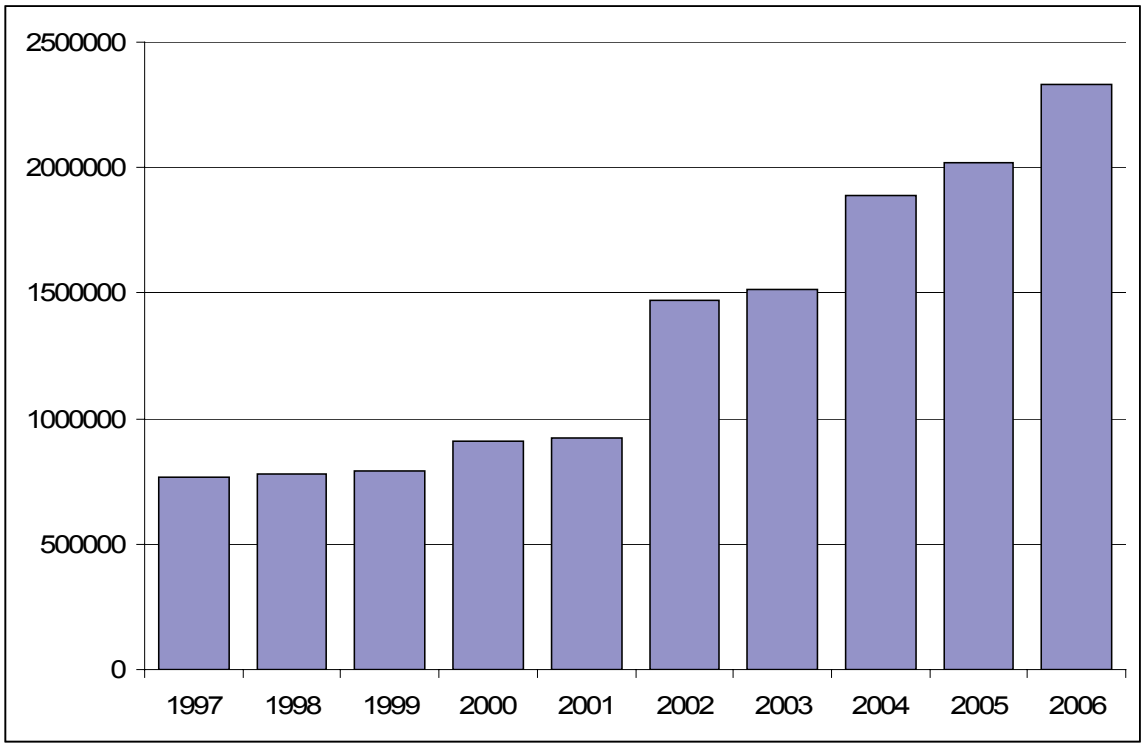
JEL Classification: J22, J18

## 1. Introduction

A simple look at the performance of the Brazilian Disability Benefits on the last years would puzzle any observer and raise number of questions. What caused the abrupt increment in the number of benefits after 2001? Given that, what are (if there is any) the disincentives created by the current rules of the system?

Graph 1 – New Claims of Sickness Benefits
(Occupational and Non-occupational Related Benefits)




There are some possible explanations, structural and non-structural reasons, for such increment on these benefits. They include a government resolution[1], which affected the rules about the medical procedures to evaluate DI claims; the New Old Age/ Length of Contribution Benefit Formula (that created the "Fator Previdenciário"), which may have stimulated after 1999, requirements of disability related benefits, as an alternative source of income[2]; INSS[3] workers' strikes that explain some punctual jumps in the

[1] The INSS Resolution n.60/2001 in September of 2002 abolished the necessity to homologate medical exams and gave the power of the final decision to the doctors, which now wouldn't have to subject their decision to anyone else. Even though the Resolution n.60/2001 was revoked in September of 2002, it was maintained the lack of necessity to homologate medical exams. It remains to conclude if such alteration in these operational rules represents an upgrade in the efficiency of the process, resulting in a faster provision of services, or if such Resolution opened a hole on the legislation and allowed fraud and the grant of unnecessary benefits.

[2] Due to the fact that old age benefits were now under rules that would propitiate higher payments for those who retired latter. The "Fator" rewarded (longer) years of contribution and resulted in a smaller replacement ratio relative to the previous replacement ratio of 100%. This possible explanation could be

number of granted benefits after the end of the strike. Concerned with this problem, the Brazilian Government attempted to introduce some marginal reforms on the bureaucratic concession process trying to increase efficiency of the system, since deeper reforms on the Social Security are a political challenge to any government[4].

A number of researchers have sought to explain the interaction between social insurance programs and labor force participation. Most of the literature on Disability Insurance (DI) disincentive effects studies the American system and the results are defined by the peculiarities of its program design. The different methodology implemented on the various studies contributes significantly to the discussion of the problem. However, to address the same disincentive issue in Brazil, the methodology usually employed cannot be replicated due to the lack of data.

For that reason, this paper will address this issue in a slightly different way and it will end up answering another important and interesting question. It will examine the impact of the existence of a Public Social Security System which provides disability insurance benefits on the labor market and the results would suggest the degree of the disincentive effects of such benefits. The empirical strategy will be based on the system's rule that covers only formal sector workers and it will take advantage of the considerate proportion of workers on informal jobs in the Brazilian labor market.

Therefore, this paper attempts to signalize some possible disincentives created by the system based on the differences between formal sector and informal sector' workers behavior. Since only formal sector worker are beneficed by the system, a comparison between formal and informal sector workers with same health conditions concerning absence in the job could signalize that DI benefits encourage workers to leave momentarily the job market.

The paper is organized as follow. Section 2 describes briefly the Brazilian Social Security Disability System and shows some statistics that help to illustrate current situation and motivate the study. Section 3 presents a literature review describing how the topic has been analyzed by other researchers. The next two sections describe the data and methodology employed to address the issue. The sixth section brings some results signalizing that formal sector workers, covered by the system, tend to be "on leave" and take advantage of the Disability Insurance (DI) more frequently than informal sector workers. The last section signalizes future steps of this research.

## 2. Disability Insurance Benefits: Rules of the System

The Disability Program in the Brazilian Pension System comprises three main classes of benefits: sickness benefit, disability pension and occupational injury benefit, which itself encloses a sickness benefit, a disability pension and an accident

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justified by the sharp difference in the disability pension's behavior and by the change in the age-distribution of this kind of benefit after 1999. However, this is just speculation since there is no way to confirm that there was really an intentional transfer from regular retirement benefits to disability ones. The only possible action to be taken to avoid the grant of unnecessary disability pensions is to improve the medical investigation procedures, action crucial to develop the system as a whole.

[3] INSS stands for Instituto Nacional de Seguridade Social; it is the national institute which controls the Social Security System.

[4] Deliberalli (2004)

compensation benefit. Moreover, the law guarantees rehabilitation for totally or partial incapable beneficiaries and habilitation to handicapped workers.

- Sickness Benefit

Workers become eligible to the sickness benefit if disease results in incapacity to work. It is a temporary benefit and its payment starts after 16 days of absence or after the date the benefit was claimed if there is more than 30 days difference between this date and the beginning of the absence period. The first 15 days of absence are paid by the employee. The vesting period is 12 months and the benefit corresponds to 91% of "salário-de-benefício[5]". There is no maximum period of payment of this benefit specified by law, even though sickness benefit is considered a temporary benefit.

- Disability Pension

Workers become eligible if considered incapable to undertake activity to guarantee his/her financial support and is considered unsuitable for rehabilitation. As in the sickness benefit, employees pay the first 15 days of absence and the benefit's payment starts after the end of sickness benefit's payment. If there was no anterior sickness benefit, the payment may starts after 16 days of absence or after the date the benefit was claimed if there is more than 30 days difference between this date and the beginning of the absence period. The vesting period is 12 months and the benefit corresponds to 100% of "salário-de-benefício". Moreover, the benefit value is supplemented by 25% if beneficiary necessitates constant personal care.

- Occupational Injury Benefits

The system of occupational injury benefits encloses a sickness benefit, a disability pension and an accident compensation benefit. For the first two kinds of benefits, the benefits are calculated at the same way as described before. The difference in the case of work-related benefits is that there is no vesting period.

Considering the accident compensation benefit, workers become eligible if work related accident result in diminished work capacity. It is independent of any other remuneration and starts after the end of the sickness benefit payment. It corresponds to 50% of "salário-de-benefício", it can't be paid when worker receives any kind of retirement/disability pension but it is incorporated to the wage when the calculation of the retirement

- Professional Rehabilitation

The law guarantees rehabilitation for totally or partially incapable beneficiaries and habilitation to handicapped workers, including the supply of prosthesis and instruments that could attenuate the loss of capacity or mobility.

In order to relocate and guarantee the participation on the labor market of the disable workers, the government requires that firms with more than 100 employees have to fulfill between 2% and 5%, depending on the number of employees[6], of their

[5] "Salário-de-Benefício" is the base for all the benefits of the Social Security System. For the Disability Benefits, "salário-de-benefício" is the average of the 80% highest wages/remuneration since July 1994. The Government is trying to change this formula for some disability related benefits as it will be discussed later. However, nothing was approved by Congress yet.

[6] Firms need to fulfill their labor force with disable and rehabilitee workers by the following rule:

From 100 to 200 employees: 2%
From 201 to 500 employees: 3%
From 501 to 1000 employees: 4%
More than 1000 employees: 5%

labor force with disable and rehabilitee workers. However, it is necessary investigate to what extent this rule is obeyed by the firms and what are the penalties for its non-compliance.

It worth mention that all the benefits are inflation indexed and are updated once a year using the Consumer Price National Index (INPC). Moreover, there is an inferior limit for the benefits equal to the minimum wage.

This paper is concerned with Sickness benefits and Occupational Injury Benefits and, to use the standard terminology ones find on literature, it calls both of them as Disability Insurance (DI) Benefits.

## 3. Literature Review

This section will summarize some studies on the disability insurance (DI) disincentive effects on the USA, describing the characteristics of the American system. The main differences between the American and the Brazilian system and data availability will be emphasized in order to justify the methodology applied on this paper.

The major problem in identifying disincentive effects of DI programs is the absence of information about potential labor supply of beneficiaries and the main methodological problem faced by researchers when addressing these impacts on labor force participation (LFP) is the endogeneity of DI benefit receipt. Participation on DI programs is a combination of individual decisions to apply for the program and individual's characteristics which define worker's eligibility to the program. Therefore, the outcome, i.e. be awarded with a DI benefit cannot be treated as exogenous variable in a labor force participation equation.

To deal with this endogeneity problem, some studies tried to model LFP as a function of potential benefit levels to wage, known as the replacement rate. However, this method presents some problems as well. Depending on the mechanism of benefit calculation, the replacement ratio may differ among workers with different wage levels and work history. Then, since benefit depends on past wages, it depends on past work decisions. As a result, the replacement rate cannot be considered an exogenous variable also. Moreover, the replacement rate combines wage and benefit levels, confounding their impact on LFP.

The brief description of the American system follows Chen and Van der Klaauw (2006). The American network protection for the disable comprehends two federal programs: the Social Security Disability Insurance (SSDI) Program and the Supplement Security Income (SSI) program. The SSDI program is part of the Old-Age Survivor and Disability Program funded mainly through payroll taxes (all workers contribute to the SSDI trust fund through their Social Security taxes). Eligibility is conditioned on previous sufficient employment in jobs covered by Social Security. The SSI program provides a minimum level of income to needy aged and disables individuals subject to an earning and assets test, not requiring previous employment.

Programmatic reforms in USA in 1984 expanded the original narrow mandate of the DI program to encompass a broader population with a less precisely defined entitlement to benefits. Moreover, the advances of medical treatments and rehabilitation

process turned the frontier between "permanently and totally disable" and "disable but with some work capacity" subtler than ever. The combination of these medical and rehabilitation advances and looser entitlement rules resulted then in an increase of DI benefits, rather than a decrease that would be expected from the medical and work condition improvements.

American disability determination process is based on medical and vocational factors such age, education and past employment, all used to determine individual's ability to work. After going through nonmedical criteria[7], severity assessment[8] evaluates if applicant has an impairment that meets a specific codified clinical criteria relating both nature and severity of impairment, which defines benefit award. If benefit is not awarded, the next step is to evaluate applicant's ability to work, based on his/her characteristics including health conditions. If offices concluded that the applicant cannot work, then benefit is awarded. It is evaluated the individual's ability to perform the job he had before the onset of the disability and the applicant's residual functional capacity to work as well. If he is considered able to perform his past job, benefit is denied. If he is considered unable to perform his past job, than he moves to the next stage where the residual functional capacity determined before is combined with vocational characteristics as age, education and work experience to determine if applicant can carry out alternative types of work in the economy, other than the one he has held. A grid is provided to guide on the decision. The grid regulations, formalized in 1978, relate certain workers characteristics such as age, education and past work experience to the individual's residual capacity to perform work-related physical and mental activities. Individuals are characterized into different age groups (under age 45, 45 to 49, 50 to 54, and 55 and over) and in different residual functional capacity of the worker (sedentary, light or medium) determined previously based on medical conditions, and person's experience and skill level. When applicant's request is denied, it is possible to appeal

Disability rolls grew in USA mostly due to liberalization of the screening process that shifted the composition of beneficiaries toward claimants with lower mortality disorders. Legislation changes in 1984 which expanded the definition of disability to consider not only health impairments but to consider "ability to function in a work-like setting", shifted the focus from medical criteria only to functional criteria, affecting considerably the decision making. Moreover, the rising financial incentives to apply for a disability award and changes in labor force participation that increase the share of citizens insured are additional contributors for disability rolls growth. An interaction between the disability benefit formula and the growth of earnings inequality in the US economy resulted in substantial replacement rates increments. Replacement rate increases for some specific group of workers which saw their real wage drop sharply suggests that DI became more attractive to these workers.

A series of studies have attempted to evaluate the work capability of DI claimants and measure the degree of disincentive attributed to the DI programs in USA.

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[7] Nonmedical criteria: to be eligible, individuals must be under 65 (and now 67 for those born in 1960 or later), must have worked for at least 5 of the last 10 years and cannot be "engaged in a substation gainful activity" (no more than $860 monthly earnings in 2006).

[8] Impairment is considered to be severe if it meets the duration test, i.e. the impairment is expected to last at least 12 months, or result in death, and significantly limits the physical or mental ability of an individual to perform his work-related activities.

Parson (1980) modeled labor force participation as a function of replacement rates, demographic and health characteristics. He compared labor force participation rates of those with high and low replacement rates. The difference in participation rates among these two groups is taken to be an estimate of DI's impact or disincentive. However, as mentioned before, this strategy doesn't consider the endogeneity of replacement ratios. Since replacement ratios are a decreasing function of past earnings and incentive structure, it is not possible to determine whether it is generous replacement rates or low earnings that induced individuals to leave labor force.

Bound (1989) suggested that there is a causal connection between the availability and generosity of DI benefits and the increasing proportion of older men leaving the labor force in order to qualify for the benefits. And this explanation emerged from the fact that the proportion of older men out of the labor force increased as DI benefits were growing rapidly due to higher availability and generosity of the system. His estimation strategy considered rejected applicant as a natural control group for the beneficiaries. He assumed that rejected applicants are healthier and more capable of work than those who were accepted and, therefore, their labor force participation should provide an upper bound for what could be expected of DI beneficiaries.

The data available allows obtaining the LFP for beneficiaries (after some period of time following benefit award) and the LFP of non-beneficiaries (after some period of time following request denial). However, we could never observe the LFP of beneficiaries had they not received the benefit. To better understand the methodology, consider the general problem. Let $y_i$ be the outcome measure and $t_i$ the treatment indicator. The treatment effect would be measures by $E[ ( y_i(1) – y_i(0) ) / t_i = 1 ]$. It is possible to observe $E[y_i(1) / t_i = 1]$ and $E[y_i(0) / t_i = 0]$. However, we don't observe $E[y_i(0) / t_i = 1]$ which hamper the determination of the treatment effect. Bound argued that rejected applicants are generally healthier than accepted applicants, i.e. $E[y_i(0) / t_i = 1] < E[y_i(0) / t_i = 0]$. For that reason, the LFP of these rejected applicants could be treated as an upper bound for the percentage of DI beneficiaries who would have worked in the absence of the program. Therefore, by restricting the sample to applicants only, he was able to obtain an upper bound on the average treatment effect on the treated

$$| E[ ( y_i(1) – y_i(0) ) / t_i = 1 ] | \leq | E[y_i(1) / t_i = 1] – E[y_i(0) / t_i = 0] |$$

The results showed that fewer than 50% of rejected male applicants work and then he concludes that less than half of those on DI would work were they not receiving benefits.

As Autor and Duggan (2006) observed, this methodology may be biased towards underestimating the labor supply disincentive of Disability Insurance system for two reasons: "some rejected applicants may remain out of labor force because they are reapplying for DI while other rejected applicants may be unable to find re-employment because their skills and opportunities deteriorated during the application process". Another limitation of this methodology were the fact that not disable but low skills workers that would not be working anyways but filled applications would distort this comparison between rejected and non-rejected claimants.

Chen and Van der Klaauw (2006) evaluate work disincentive effects of DI programs during the 1990s. They replicate the Bound upper bound for work disincentive

effect of the current program and subsequently they adopt a Regression-Discontinuity approach to provide a point estimate of the impact of the DI program on a subset of applicants. More specifically, they exploit the particularities of the determination process that access the residual capacity of worker based on the grid causing a discontinuity on the probability to be awarded depending on age.

Their estimates imply an upper bound on the reduction in the employment rate of applicants associated with disability benefit receipt around 15 percentage points, suggesting an smaller disincentive than the one estimated by Bound[9].

Exploiting the fact that about 40% of applicants for whom disability determination was not resolved based on medical grounds and had to be based on vocational grounds with the help of a grid, the authors used a regression-discontinuity to evaluate disincentive effects of DI benefits on an important subset of applicants (that reached the final stage in the screening process). They present an example of the grid impact on disability determination to illustrate how its use leads to discontinuities in the award rate as a function of age: "Consider an applicant who has less than a high school education, is (semi) skilled and who cannot easily enter into another profession, and whose disability limits her to light work. Then according to the (…) grid (…) the applicant would be accepted if she was 55 or older at the time of the disability decision. However, if she was less than 55 years of age at that time, she would be rejected" (Chen and Van der Klaauw, 2006). As the individuals are of similar age when they are just below or above the cutoff age, those just below the cutoff age can be expected to be comparable to the individuals just above in all characteristics and consequently they are expected to have similar labor supply responses when receiving or not DI benefits. Therefore, the authors defend the idea that the average LFP of individuals just below the cutoff age could be a credible estimate of the LFP of those just above the cutoff would have been they were not awarded with the DI benefit.

They apply two different methods to estimate the average treatment effect: the two-stage method proposed by Van der Klaauw (2002) and a local Wald estimator. The two-stage method proposed involves the estimation of a control function augmented labor supply equation where the DI program participation variable is replaced by a propensity score previously estimated. Since the grid creates three potential discontinuity points, the DI benefit impact estimated represents an estimate of a weighted average of the three local treatment effects.

The short-run sample[10] estimate based on the two-stage approach reveals that DI benefit receipt reduces the LFP in 20% between those applicants where the definition about their disability status were made at the last stage of the screening process. And a surprisingly result showed an estimate of a 6 percentage point drop in LFP due to DI benefit receipt in the long-run sample[11] revealing that giving more time to re-entry into the labor force is not important. "Overall the estimates imply that, depending on the particular estimation method used, the work disincentive effects associated with DI benefit receipt for the marginal group of stage 5 applicants were either slightly lower or higher than those obtained using Bound's comparison group approach, but with all estimates representing modest impacts."

[9] Authors discuss some potential reasons for the different results. For more detail check reference.
[10] Between 1 and 24 months after date of award decision.
[11] Between 1 month and 11 years after date of award decision.

The American and the Brazilian system present some significant differences, resulting in diverse disincentive effects. The grant rule in the American and Brazilian Social Security Systems are not the same and the degree of discouragement brought to the labor markets will be different as well.

The Brazilian screening process does not follow so many steps to identify who is and who isn't disable. The decision is based on health status and capacity to carry out worker's "current" job. The fact that Brazilian rules require workers to be currently enrolled in jobs covered by Social Security represents a significant difference between the two systems. As a result, evaluate worker residual capacity to work would suggest that applicant would have to leave current job and find another one fitted to his possibilities, in case he is not considered unapt to perform current job.

Two potential consequences of the design differences should be considered. First, because American system eligibility requirements are conditioned on the applicant not to be engaged in any activity which is both "substantial and gainful", the system as it is could create higher incentives for non-labor participation. However, since the American screening process final step access residual functional capacity, i.e. it verifies whether the applicant can carry out any type of work in the economy, it could be grating benefits to truly disable workers more frequently than the Brazilian system.

The strategy used by the papers just described could not be the approach to analyze the disincentive effects of disability insurance benefits in the Brazilian case due to the lack of data. Considering Brazilian data availability, this paper will address this issue in a slightly different way but it will end up answering another important and interesting question. This paper will examine the impact of the existence of a Public Social Security System which provides disability insurance benefits on the labor market. The results would suggest the degree of the disincentive effects of such benefits. The empirical strategy will be based on the system's rule that covers only formal sector workers and it will take advantage of the considerate proportion of workers on informal jobs in the Brazilian labor market.

## 4. Data and Empirical Strategy

This paper uses data from the Brazilian Household Survey PNAD (Pesquisa Nacional por Amostras de Domicílios) 2003, which brings a supplement about health conditions. One of the biggest obstacles to be surpassed in order to address the DI disincentive question as the literature does would be to identify workers under DI benefit, since there is no specific question about that on PNAD. Other Brazilian Household Surveys would allow such identification but would not contain satisfactory information about posterior LFP.

However, the system only covers formal sector workers. In that sense, informal sector workers would provide a control group for formal sector workers. Controlling for demographic, labor sector, occupation and health conditions, formal sector workers would have a smaller labor force participation than informal sector workers if the DI benefit causes some disincentive to come back to the labor force or to leave it momentarily. More specifically, the probability of a formal sector worker to be "on leave" would be higher than the same probability for informal sector workers, controlling for health conditions. For that reason, the comparison between formal and informal sector

workers would bring some light to the discussion about the disincentives caused by DI benefits.

Table 1 presents some descriptive statistics of the sample of formal and informal sector workers. As it would be expected, formal and informal sector workers present differences in almost all demographic and occupational characteristics. Workers enrolled in formal jobs are mainly married white man, more educated than informal sector workers. They live with their spouses and have kids, perform jobs in Manufacturing or Services.

Considering health conditions of the sample, workers who declared themselves with excellent health conditions belong mostly to formal sector jobs. On the other hand, workers who declared themselves with regular, poor or very poor condition work mainly in informal sector positions. Another interesting information reveals that more then 57% of informal job workers declared that didn't undertake some activity on the week before of the survey for health reasons. Among formal sector workers, only 42.4% had the same problem.

## 5. Methodology

Differences on the labor market, on the program design and on the data availability requires an alternative methodology to address the issue of DI programs disincentive effects. This will compromise any result comparisons with the previous literature for the American system. However, it will hopefully contribute to the discussion of disincentive effects of DI benefits.

The same issues faced by the analysis of DI disincentive effects concerning endogeneity problems would be found here since it is not clear whether a causal link between formality and LFP is identified because of standard endogeneity problems. Under endogeneity scenario, unobserved attributes which make job formality more likely may be correlated with LFP (a binary variable) and, therefore, a single equation estimate of the effect of a formal job on LFP (equation 1) would be biased. The propensity to be a formal sector worker ($t_i = 1$) is likely to be correlated with factors that influence the LFP or the probability of be "on leave".

$$LFP_i = \alpha + \beta X_i + \gamma t_i + \varepsilon_i \qquad (1)$$

To deal with this potential bias due to unobserved heterogeneity and endogeneity problems, Rosembaum and Rubin (1983) develop the propensity score matching estimators. In this method, each treatment unit (covered or formal sector workers) is matched with non-treatment units (non covered or informal sector workers) under the assumption of conditional independence, i.e. $LFPi \perp t_i / Xi$ and common support, i.e. $0 < Prob(t_i = 1 / Xi) < 1$, (Mocan and Tekin, 2002)

Each formal sector worker (treated unit) can be matched with an informal sector worker (control unit) and the average treatment effect is calculated as the mean within-match difference in the outcome variable (be on leave) between treated and nontreated observations.

The idea behind of propensity score method is that conditional independence and common support assumption imply that "whereas one conditional on X in traditional matching estimators, in propensity score matching estimators on conditions on the propensity score, because observations with the same propensity score have the same distribution of covariates, X" (Mocan and Tekin, 2002). Therefore:

$$LFP_i \perp t_i / p(X_i) \text{ and } 0 < Prob(t_i = 1 / p(X_i)) < 1$$

The first step of the method is the estimation of a logistic regression to estimate the propensity score. "Rosembaum and Rubin (1983) defines a propensity score as a function of the vector X, such that $X_i \perp t_i / p(X_i)$, i.e., conditional on the propensity score, the covariates are independent of assignment to treatment." (Mocan and Tekin, 2002). Therefore, the distribution of the variables in vector X should be the same across treated and nontreated for observations with the same propensity score, known as Balance Property.

The second step involves the estimation of the average treatment effect on the treated (ATT). Following (Mocan and Tekin, 2002), the ATT estimation can be specified as:

$$\begin{aligned} E(\Delta_i / t_i = 1) &= E\{(LFP_i = 0, LFP_i = 1) / t_i = 1\} \\ &= E\{E\{(LFP_i = 0, LFP_i = 1) / t_i = 1, p(X_i)\}\} \\ &= E\{E\{LFP_i = 1 / t_i = 1, p(X_i)\}\} - E\{E\{LFP_i = 0 / t_i = 1, p(X_i)\}\} \end{aligned}$$

The empirical strategy in this paper chose to estimate the probability of $LFP_i = 1$ (in this context, probability of worker be "on leave") among workers with similar propensity score (that in this paper means the probability to work in a formal sector job). Five groups were defined based on the estimated probability to be a formal sector worker. Then, for workers in each of these five groups, it was estimated the probability to be on leave as follows:

$$LFP_{ij} = \alpha_j + \beta Z_{ij} + \gamma t_{ij} + \varepsilon_{ij} \qquad (2)$$

Where vector Z contains health conditions variables. Equation (2) estimates for workers with the same propensity, the impact of have a formal sector job and then be covered by the DI benefit, on the probability to be "on leave". Each of the j equations estimated consider workers with similar propensity.

## 6. Results

The Appendix presents the results of the logits estimated. To obtain the propensity to work in formal sector job, the first step was to estimate a logit separately for men and women based on their other demographic and labor market characteristics[12]. Table 2 shows that all variables turned out to be significant on the determination of such probability.

[12] Public sector workers were not included in the sample, only private sector workers.

Based on these results, workers were classified in five groups based on the estimated probability or propensity to work in a formal sector job. As it was expected, workers with higher propensity to be a formal sector worker are more educated and perform their activities in the manufacturing sector or services sector. Moreover, they tend to have better health conditions and have a smaller chance to not have performed recently some activity for health reasons.

The next step to access the disincentive impact of the social security system is to estimate the LFP or, more specifically, the probability to be "on leave", among workers with the same propensity to be formal sector workers. The Balance Property, which requires that the distribution of the variables in vector of exogenous variables should be the same across formal (treated) and informal (nontreated) sector workers for observations with the same propensity score, seems to be satisfied (see Table 4).

The results for the estimation of the probability to be "on leave" controlling for worker's health conditions can be observed in Table 5 and they suggest the existence of disincentives created by the Disability System. Among workers with the same propensity to be in the formal sector, the ones truly occupied in formal jobs have higher probability to be "on leave". For the five different groups based on the probability to work as a formal worker, to actually have a formal sector job increases the probability to be "on leave" in more than 1.1 points (results go from 1.11 and 1.22 depending on the propensity to be in the formal sector).

## 7. Conclusions

This paper took advantage of the high proportion of informal sector workers, uncovered by the social security system, to analyze the impact of such system on the labor force participation of Brazilian workers. After controlling for the demographic and labor market characteristics, informal sector workers would be a control group for formal sector workers covered by the social security system.

To deal with the endogeneity of the variable which identify formal and informal sector workers in a single LFP equation estimation, the probability to be "on leave" was estimated separately for workers with the same propensity to work in a formal sector job.

The results reveal that workers in the formal sector have higher probability to be on leave, even after controlling for health conditions, which suggests the degree of disincentive created by such social protection system.

According to Dehejia and Wahba (2002) there is a range of methods to evaluate the average treatment effect on the treated (ATT), which employ different matching methods. The application of such matching methods will be the next step of this research, allowing the measurement of this ATT.

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# Appendix

**Table 1 - Descriptive Statistics - Formal x Informal**

| | Formal | Informal | Formal % | Informal % | Formal % | Informal % |
|---|---|---|---|---|---|---|
| Male | 19.843.138 | 21.036.929 | 61,97 | 62,40 | 48,54 | 51,46 |
| Female | 12.177.417 | 12.676.099 | 38,03 | 37,60 | 49,00 | 51,00 |
| Married | 19.811.117 | 19.607.497 | 61,87 | 58,16 | 50,26 | 49,74 |
| White | 19.942.402 | 15.454.052 | 62,28 | 45,84 | 56,34 | 43,66 |
| Education | | | | | | |
| less than 1 year | 1.575.411 | 5.228.891 | 4,92 | 15,51 | 23,15 | 76,85 |
| between 1 and 4 years | 5.446.696 | 10.066.710 | 17,01 | 29,86 | 35,11 | 64,89 |
| between 5 and 8 years | 7.700.943 | 9.840.833 | 24,05 | 29,19 | 43,90 | 56,10 |
| between 9 and 14 years | 13.688.787 | 7.639.372 | 42,75 | 22,66 | 64,18 | 35,82 |
| 15 years or more | 3.608.717 | 933.851 | 11,27 | 2,77 | 79,44 | 20,56 |
| Ocupation | | | | | | |
| Managers | 2.769.778 | 923.737 | 8,65 | 2,74 | 74,99 | 25,01 |
| Scientists and Artists | 2.455.977 | 1.166.471 | 7,67 | 3,46 | 67,80 | 32,20 |
| Techinicians | 2.926.679 | 1.547.428 | 9,14 | 4,59 | 65,41 | 34,59 |
| Administrative services workers | 4.383.614 | 1.139.500 | 13,69 | 3,38 | 79,37 | 20,63 |
| Services employees | 6.359.282 | 7.871.992 | 19,86 | 23,35 | 44,69 | 55,31 |
| Salesman | 2.923.477 | 4.426.521 | 9,13 | 13,13 | 39,78 | 60,22 |
| Rural workers | 1.732.312 | 7.501.149 | 5,41 | 22,25 | 18,76 | 81,24 |
| Industry employees | 8.431.012 | 9.102.518 | 26,33 | 27,01 | 48,09 | 51,91 |
| Militaries | 25.616 | 6.743 | 0,08 | 0,02 | 79,16 | 20,84 |
| Other ocupations | 9.606 | 20.228 | 0,03 | 0,06 | 32,20 | 67,80 |
| Sector | | | | | | |
| Agriculture | 1.789.949 | 7.548.347 | 5,59 | 22,39 | 19,17 | 80,83 |
| Manufacturing | 422.671 | 134.852 | 1,32 | 0,40 | 75,81 | 24,19 |
| Transf. Manufacturing | 6.839.591 | 3.718.547 | 21,36 | 11,03 | 64,78 | 35,22 |
| Construction | 1.450.531 | 3.590.437 | 4,53 | 10,65 | 28,77 | 71,23 |
| Sales | 6.721.114 | 6.631.353 | 20,99 | 19,67 | 50,34 | 49,66 |
| Food and Lodging | 1.155.942 | 1.432.804 | 3,61 | 4,25 | 44,65 | 55,35 |
| Transport and Communication | 2.170.994 | 1.476.631 | 6,78 | 4,38 | 59,52 | 40,48 |
| Public Administration | 1.127.124 | 347.244 | 3,52 | 1,03 | 76,45 | 23,55 |
| Health and Education | 3.509.453 | 1.129.386 | 10,96 | 3,35 | 75,65 | 24,35 |
| Household | 1.809.161 | 4.345.609 | 5,65 | 12,89 | 29,39 | 70,61 |
| Other Services | 1.082.295 | 1.746.335 | 3,38 | 5,18 | 38,26 | 61,74 |
| Other Sectors | 3.919.316 | 1.442.918 | 12,24 | 4,28 | 73,09 | 26,91 |
| Non Defined Sectors | 19.212 | 171.936 | 0,06 | 0,51 | 10,05 | 89,95 |
| Family | | | | | | |
| Couple without children | 3.938.528 | 3.843.285 | 12,30 | 11,40 | 50,61 | 49,39 |
| Couple with children younger than 14 years old | 9.004.180 | 8.296.776 | 28,12 | 24,61 | 52,04 | 47,96 |
| Couple with children older than 14 years old | 7.880.259 | 7.504.520 | 24,61 | 22,26 | 51,22 | 48,78 |
| Couple with children younger and older than 14 years old | 3.948.134 | 5.474.996 | 12,33 | 16,24 | 41,90 | 58,10 |
| Couple with children (unknow age) | 0 | 0 | 0,00 | 0,00 | - | - |
| Women with children younger than 14 years old | 918.990 | 1.173.213 | 2,87 | 3,48 | 43,92 | 56,08 |
| Women with children older than 14 years old | 2.875.446 | 3.067.886 | 8,98 | 9,10 | 48,38 | 51,62 |
| Women with children younger and older than 14 years old | 541.147 | 984.420 | 1,69 | 2,92 | 35,47 | 64,53 |
| Women with children (unknow age) | 0 | 3.371 | 0,00 | 0,01 | 0,00 | 100,00 |
| Other families | 2.910.668 | 3.364.560 | 9,09 | 9,98 | 46,38 | 53,62 |
| No activity for health reasons | 1.585.017 | 2.154.262 | 4,95 | 6,39 | 42,39 | 57,61 |
| Health Conditions | | | | | | |
| Excelent | 8.805.653 | 6.799.918 | 27,50 | 20,17 | 56,43 | 43,57 |
| Goog | 18.280.535 | 18.437.655 | 57,09 | 54,70 | 49,79 | 50,21 |
| Regular | 4.476.474 | 7.389.896 | 13,98 | 21,92 | 37,72 | 62,28 |
| Poor | 387.449 | 940.593 | 1,21 | 2,79 | 29,17 | 70,83 |
| Very Poor | 70.445 | 138.223 | 0,22 | 0,41 | 33,76 | 66,24 |
| Not declared | 0 | 3.371 | 0,00 | 0,01 | 0,00 | 100,00 |

**Table 2 - Logit Prob( Formal )**

| | Female | | Male | |
|---|---|---|---|---|
| | estimate | std error | estimate | std error |
| Intercept | -2,160 | 0,004 | -1,524 | 0,004 |
| Age | 0,002 | 0,000 | -0,008 | 0,000 |
| Age squared | 0,000 | 0,000 | 0,007 | 0,000 |
| Nonwhite | 0,086 | 0,001 | 0,075 | 0,001 |
| Education | 0,092 | 0,000 | 0,104 | 0,000 |
| In school | -0,483 | 0,001 | -0,407 | 0,001 |
| Married | 0,080 | 0,001 | 0,606 | 0,001 |
| Children younger than 6 | -0,101 | 0,001 | - | - |
| North | -0,522 | 0,003 | -0,531 | 0,002 |
| Northeast | -0,548 | 0,002 | -0,523 | 0,002 |
| Southeast | 0,279 | 0,002 | 0,381 | 0,001 |
| South | 0,418 | 0,002 | 0,381 | 0,002 |
| Metropolitan Area | 0,131 | 0,001 | 0,113 | 0,001 |
| Agriculture | 0,656 | 0,010 | 0,177 | 0,005 |
| Manufacturing | 0,987 | 0,002 | 1,416 | 0,004 |
| Construction | 1,021 | 0,008 | -0,365 | 0,004 |
| Sales | 1,028 | 0,002 | 0,431 | 0,004 |
| Food and Lodging | 0,571 | 0,002 | -0,112 | 0,004 |
| Transport and Communication | 1,379 | 0,004 | 0,629 | 0,004 |
| Public Administration | 1,626 | 0,003 | 1,669 | 0,004 |
| Health and Education | 1,627 | 0,002 | 1,155 | 0,004 |
| Other Services and Sectors | 0,519 | 0,002 | 0,461 | 0,004 |
| Managers | 1,037 | 0,003 | 0,642 | 0,002 |
| Scientists and Artists | 0,364 | 0,003 | -0,187 | 0,002 |
| Techinicians | 0,612 | 0,003 | -0,009 | 0,002 |
| Administrative services workers | 1,440 | 0,003 | 1,011 | 0,002 |
| Services employees | 0,561 | 0,002 | 0,622 | 0,001 |
| Salesman | -0,244 | 0,003 | -0,190 | 0,002 |
| Rural workers | -0,387 | 0,010 | -0,634 | 0,003 |

**Table 3 - Descriptive Statistics**

| | Probf = 1 | Probf = 2 | Probf = 3 | Probf = 4 | Probf = 5 |
|---|---|---|---|---|---|
| Formal | 11,88 | 30,44 | 50,83 | 70,17 | 85,12 |
| Education | | | | | |
| less than 1 year | 40,75 | 11,02 | 4,11 | 1,5 | 0,09 |
| between 1 and 4 years | 39,88 | 38,96 | 20,92 | 11,27 | 1,78 |
| between 5 and 8 years | 16,43 | 33,88 | 34,31 | 25,84 | 13,08 |
| between 9 and 14 years | 2,94 | 15,86 | 38,11 | 48,73 | 59,86 |
| 15 years or more | 0 | 0,28 | 2,54 | 12,66 | 25,19 |
| Married | 53,89 | 58,75 | 58,86 | 61,37 | 68,81 |
| Ocupation | | | | | |
| Managers | 0,05 | 0,6 | 2,71 | 10,17 | 18,8 |
| Scientists and Artists | 0,17 | 1,24 | 5,12 | 11,11 | 10,78 |
| Techinicians | 0,32 | 2,03 | 7 | 14,13 | 10,42 |
| Administrative services workers | 0,01 | 0,19 | 2,46 | 13,22 | 35,74 |
| Services employees | 16,22 | 30,09 | 26,53 | 18,42 | 9,01 |
| Salesman | 9,68 | 16,38 | 19,15 | 4,67 | 0,36 |
| Rural workers | 55,51 | 19,42 | 2,44 | 0,28 | 0,01 |
| Industry employees | 18,04 | 30,03 | 34,5 | 27,81 | 14,68 |
| Militaries | 0 | 0 | 0,01 | 0,09 | 0,2 |
| Other ocupations | 0 | 0,02 | 0,08 | 0,1 | 0,01 |
| Sector | | | | | |
| Agriculture | 55,39 | 19,57 | 2,81 | 0,49 | 0,05 |
| Manufacturing | 0,02 | 0,12 | 0,66 | 1,58 | 2,23 |
| Transf. Manufacturing | 1,96 | 7,11 | 17,28 | 23,71 | 33,96 |
| Construction | 14,61 | 16,08 | 5,04 | 0,76 | 0,27 |
| Sales | 9,23 | 20,23 | 31,31 | 20,55 | 13,55 |
| Food and Lodging | 2,09 | 5,01 | 6,7 | 3,31 | 0,31 |
| Transport and Communication | 0,68 | 3,32 | 7,52 | 9,1 | 5,83 |
| Public Administration | 0,01 | 0,15 | 1,11 | 3,66 | 8,31 |
| Health and Education | 0 | 0,43 | 3,34 | 12,23 | 25,36 |
| Household | 14,77 | 21,77 | 6,67 | 0,32 | 0,01 |
| Other Services | 0,87 | 3,43 | 7,56 | 5,8 | 1,63 |
| Other Sectors | 0,33 | 2,48 | 9,44 | 18,2 | 8,39 |
| Non Defined Sectors | 0,04 | 0,31 | 0,55 | 0,31 | 0,08 |
| No activity for health reasons | 7,49 | 6,7 | 5,49 | 4,55 | 4,04 |
| Health Conditions | | | | | |
| Excelent | 15,55 | 17,99 | 23,94 | 28,91 | 34,8 |
| Goog | 53,49 | 55,5 | 57,02 | 56,89 | 55,46 |
| Regular | 26,34 | 23,24 | 17,05 | 13,05 | 9,08 |
| Poor | 4,12 | 2,78 | 1,69 | 0,98 | 0,53 |
| Very Poor | 0,47 | 0,48 | 0,3 | 0,17 | 0,12 |
| Not declared | 0,01 | 0,01 | 0 | 0 | 0,01 |

OBS: Probf = 1 - 0 < Prob(Formal) < 0,2
Probf = 2 - 0,2 < Prob(Formal) < 0,4
Probf = 3 - 0,4 < Prob(Formal) < 0,6
Probf = 4 - 0,6 < Prob(Formal) < 0,8
Probf = 5 - 0,8 < Prob(Formal) < 1,0

**Table 4 - Balance Property (%)**

| | Probf = 1 | | Probf = 2 | | Probf = 3 | | Probf = 4 | | Probf = 5 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Formal | Informal | Formal | Informal | Formal | Informal | Formal | Informal | Formal | Informal |
| Education | | | | | | | | | | |
| less than 1 year | 37,43 | 41,19 | 11,65 | 10,75 | 4,77 | 3,43 | 1,51 | 1,47 | 0,1 | 0 |
| between 1 and 4 years | 43,32 | 39,41 | 38,98 | 38,94 | 20,71 | 21,14 | 11,62 | 10,46 | 1,75 | 1,97 |
| between 5 and 8 years | 15,43 | 16,56 | 30,31 | 35,45 | 31,14 | 37,6 | 24,96 | 27,94 | 12,53 | 16,21 |
| between 9 and 14 years | 3,78 | 2,83 | 18,63 | 14,65 | 40,33 | 35,82 | 48,54 | 49,18 | 59,6 | 61,34 |
| 15 years or more | 0,04 | 0 | 0,42 | 0,21 | 3,05 | 2,01 | 13,38 | 10,96 | 26,02 | 20,49 |
| Not Married | 45,57 | 46,19 | 41,3 | 41,22 | 42,38 | 39,86 | 38,21 | 39,63 | 30,24 | 36,64 |
| Married | 54,43 | 53,81 | 58,7 | 58,78 | 57,62 | 60,14 | 61,79 | 60,37 | 69,76 | 63,36 |
| Ocupation | | | | | | | | | | |
| Managers | 0,08 | 0,05 | 0,72 | 0,55 | 3,12 | 2,29 | 10,54 | 9,28 | 18,49 | 20,59 |
| Scientists and Artists | 0,21 | 0,17 | 1,11 | 1,3 | 4,98 | 5,26 | 11,2 | 10,91 | 11,09 | 8,99 |
| Techinicians | 0,84 | 0,25 | 2,45 | 1,84 | 7,3 | 6,69 | 13,76 | 15,02 | 10,4 | 10,54 |
| Administrative services workers | 0,02 | 0,01 | 0,22 | 0,17 | 2,65 | 2,26 | 14,18 | 10,97 | 35,86 | 35,11 |
| Services employees | 19,75 | 15,74 | 32,2 | 29,16 | 25,23 | 27,87 | 17,82 | 19,81 | 8,8 | 10,18 |
| Salesman | 6,24 | 10,14 | 15,62 | 16,71 | 20,17 | 18,09 | 4,4 | 5,32 | 0,37 | 0,28 |
| Rural workers | 47,96 | 56,53 | 18,97 | 19,62 | 2,22 | 2,66 | 0,28 | 0,28 | 0,01 | 0 |
| Industry employees | 24,9 | 17,12 | 28,7 | 30,62 | 34,24 | 34,77 | 27,66 | 28,17 | 14,81 | 13,89 |
| Militaries | 0 | 0 | 0 | 0 | 0,02 | 0 | 0,12 | 0,03 | 0,16 | 0,42 |
| Other ocupations | 0 | 0 | 0,01 | 0,03 | 0,05 | 0,11 | 0,05 | 0,2 | 0,01 | 0 |
| Sector | | | | | | | | | | |
| Agriculture | 47,94 | 56,39 | 19,21 | 19,73 | 2,55 | 3,07 | 0,45 | 0,59 | 0,06 | 0,03 |
| Manufacturing | 0,04 | 0,01 | 0,11 | 0,13 | 0,65 | 0,68 | 1,75 | 1,18 | 2,42 | 1,13 |
| Transf. Manufacturing | 1,99 | 1,96 | 7,41 | 6,97 | 17,32 | 17,23 | 23,82 | 23,45 | 34,63 | 30,12 |
| Construction | 21,69 | 13,66 | 14,83 | 16,63 | 4,35 | 5,76 | 0,84 | 0,56 | 0,25 | 0,41 |
| Sales | 6,60 | 9,59 | 19,56 | 20,52 | 32,32 | 30,27 | 20,01 | 21,83 | 13,78 | 12,26 |
| Food and Lodging | 1,75 | 2,13 | 5,21 | 4,92 | 6,68 | 6,73 | 3,12 | 3,75 | 0,32 | 0,25 |
| Transport and Communication | 0,43 | 0,72 | 2,58 | 3,64 | 7,97 | 7,07 | 9,25 | 8,75 | 5,89 | 5,50 |
| Public Administration | 0,00 | 0,01 | 0,36 | 0,06 | 1,47 | 0,75 | 3,97 | 2,93 | 7,73 | 11,66 |
| Health and Education | 0,02 | 0,00 | 0,82 | 0,26 | 4,04 | 2,61 | 12,29 | 12,07 | 24,93 | 27,77 |
| Household | 17,45 | 14,41 | 22,75 | 21,34 | 5,54 | 7,85 | 0,25 | 0,46 | 0,00 | 0,05 |
| Other Services | 0,73 | 0,89 | 2,10 | 4,01 | 4,87 | 10,33 | 4,56 | 8,72 | 1,42 | 2,85 |
| Other Sectors | 1,36 | 0,19 | 5,02 | 1,36 | 12,14 | 6,66 | 19,62 | 14,85 | 8,52 | 7,69 |
| Non Defined Sectors | 0,00 | 0,05 | 0,03 | 0,43 | 0,09 | 1,02 | 0,07 | 0,85 | 0,05 | 0,26 |
| No activity for health reasons | 6,63 | 7,61 | 6,53 | 6,77 | 5,33 | 5,65 | 4,49 | 4,69 | 3,89 | 4,92 |
| Health Conditions | | | | | | | | | | |
| Excelent | 15,71 | 15,53 | 18,96 | 17,57 | 24,90 | 22,94 | 29,54 | 27,43 | 34,97 | 33,82 |
| Goog | 58,42 | 52,82 | 57,42 | 54,66 | 58,09 | 55,91 | 57,07 | 56,45 | 55,61 | 54,57 |
| Regular | 21,97 | 26,93 | 21,09 | 24,18 | 15,47 | 18,69 | 12,26 | 14,89 | 8,80 | 10,72 |
| Poor | 3,27 | 4,24 | 2,15 | 3,05 | 1,31 | 2,08 | 0,96 | 1,03 | 0,48 | 0,82 |
| Very Poor | 0,63 | 0,45 | 0,38 | 0,53 | 0,22 | 0,38 | 0,17 | 0,19 | 0,13 | 0,07 |
| Not declared | 0,00 | 0,02 | 0,00 | 0,01 | 0,01 | 0,00 | 0,00 | 0,00 | 0,01 | 0,00 |

OBS: Probf = 1 - 0 < Prob(Formal) < 0,2
Probf = 2 - 0,2 < Prob(Formal) < 0,4
Probf = 3 - 0,4 < Prob(Formal) < 0,6
Probf = 4 - 0,6 < Prob(Formal) < 0,8
Probf = 5 - 0,8 < Prob(Formal) < 1,0

**Table 5 - Logit Prob( On Leave )**

| | Probf = 1 | | Probf = 2 | | Probf = 3 | | Probf = 4 | | Probf = 5 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | estimate | std error | estimate | std error | estimate | std error | estimate | std error | estimate | std error |
| Intercept | -5,298 | 0,010 | -5,680 | 0,008 | -5,687 | 0,007 | -5,599 | 0,007 | -5,903 | 0,012 |
| **Formal** | **1,149** | **0,007** | **1,210** | **0,004** | **1,220** | **0,005** | **1,158** | **0,006** | **1,110** | **0,011** |
| Female | -0,322 | 0,007 | -0,026 | 0,004 | 0,236 | 0,004 | 0,203 | 0,004 | 0,565 | 0,005 |
| No activity for health reasons | 1,890 | 0,007 | 1,903 | 0,005 | 2,087 | 0,005 | 2,276 | 0,005 | 2,132 | 0,006 |
| Goog Health Condition | 0,180 | 0,011 | 0,426 | 0,008 | 0,153 | 0,006 | 0,083 | 0,005 | 0,235 | 0,007 |
| Regular Health Condition | 0,514 | 0,012 | 1,078 | 0,008 | 0,987 | 0,007 | 0,878 | 0,006 | 1,086 | 0,008 |
| Poor Health Condition | 1,607 | 0,013 | 1,873 | 0,010 | 1,688 | 0,009 | 1,842 | 0,009 | 2,097 | 0,015 |
| Very Poor Health Condition | 0,143 | 0,035 | 1,608 | 0,017 | 2,030 | 0,016 | 2,337 | 0,017 | 2,378 | 0,026 |
| Estimated Probability | | | | | | | | | | |
| On Leave = 1 | 1,24672 | | 1,60699 | | 1,79104 | | 1,88369 | | 1,7759 | |

OBS: Probf = 1 - 0 < Prob(Formal) < 0,2
Probf = 2 - 0,2 < Prob(Formal) < 0,4
Probf = 3 - 0,4 < Prob(Formal) < 0,6
Probf = 4 - 0,6 < Prob(Formal) < 0,8
Probf = 5 - 0,8 < Prob(Formal) < 1,0